C_p = The specific heat at constant pressure, in -calories per gram degree centigrade (BTU/lb °F.); and

C_v = The specific heat at constant volume, in -calories per gram degree centigrade (BTU/lb °F.).

(4) The required total venting capacity determined by using table I or paragraph (d)(3) of this section may be reduced for insulated tanks to Q_t by the following formula:

$$Q_t = FQ_1$$

where:

Q_t = The total required venting capacity of the insulated tank;

Q_1 = The total venting capacity required for an uninsulated tank according to table I or paragraph (d)(3) of this section;

F = A coefficient with a value greater than or equal to 0.25 according to the following formula:

Formula for metric units

$$F = 8U(649–t) / 93.5 \times 10^6$$

Formula for nonmetric units

$$F = 8U(1200–t) / 34{,}500$$

where:

U = The thermal conductance of the insulation system taken at 38 °C (100 °F), in gram calories per hour square meter °C (BTU per hour square feet °F); and

t = The actual temperature of the substance at loading, in °C (°F).

(5) Insulation systems, used for the purpose of reducing the venting capacity, must be approved by the approval agency. In all cases, insulation systems approved for this purpose must:

(i) Remain effective at all temperatures up to 649 °C (1200 °F); and

(ii) Be jacketed with a material having a melting point of 649 °C (1200 °F) or greater.

(6) The flow capacity rating of any pressure relief device must be certified by the manufacturer to be in accordance with the applicable provisions of the ASME Code with the following exceptions:

(i) The ASME Code stamp is not required; and

(ii) The flow capacity certification test for spring loaded pressure relief valves may be conducted at a pressure not to exceed 120% of the set pressure provided the stamped flow capacity rating is not greater than 83% of the average capacity of the valves tested.

(e) *Markings on pressure and vacuum relief devices.* The following information shall be plainly displayed on each pressure relief device:

(1) The pressure or, when appropriate, the temperature at which the device is set to function;

(2) Except for vacuum relief devices, the rated flow capacity of air discharged per minute at 15 °C (59 °F) and atmospheric pressure, at:

(i) The set pressure for rupture discs;

(ii) No greater than 20% above the start-to-discharge pressure for spring-loaded relief devices; or

(iii) The fusing temperature for fusible elements.

(3) The manufacturer's name and catalog number; and

(4) The allowable tolerances at the start-to-discharge pressure and the allowable tolerances at the discharge temperature.

[Amdt. 178–65, 46 FR 9897, Jan. 29, 1981; 46 FR 24184, Apr. 30, 1981, as amended by Amdt. 178–97, 55 FR 52716, Dec. 21, 1990; Amdt. 178–99, 58 FR 51534, Oct. 1, 1993; Amdt. 178–104, 59 FR 49135, Sept. 26, 1994; 66 FR 45386, 45389, Aug. 28, 2001]

§ 178.270–12 Valves, nozzles, piping, and gauging devices.

(a) All tank nozzles, except those provided for filling and discharge connections below the normal liquid level of the tank, relief devices, thermometer wells, and inspection openings, must be fitted with manually operated stop valves located as near the shell as practicable either internal or external to the shell. Each filling and discharge connection located below the normal liquid level of the tank must be equipped with an internal discharge valve. A tank nozzle installed in the vapor space to provide a filling or cleaning opening, which is closed by a blank flange or other suitable means, need not be provided with a manually operated stop valve. A tank nozzle installed for a thermometer well or inspection opening need not be provided with a manually operated stop valve.

(b) Each valve must be designed and constructed to a rated pressure not less than the MAWP of the tank. Each stop valve with a screwed spindle must be closed by a clockwise motion of the

handwheel. All valves must be constructed to prevent unintentional opening.

(c) Each internal discharge valve shall be self-closing, located inside the tank, within the welded flange or within its companion flange.

(d) A shear section must be located outboard of each internal discharge valve seat and within 10.2 cm (4 inches) of the vessel. The shear section must break under strain without affecting the product retention capabilities of the tank and any attachments.

(e) All piping must be of suitable material. Welded joints must be used wherever practicable. The bursting strength of all piping and pipe fittings must be at least 4 times the MAWP of the tank. Piping must be supported in such a manner as to prevent damage due to thermal stresses, jarring or vibration.

(f) All nozzles and tank shell penetrations for nozzles shall be designed and constructed in accordance with the ASME Code.

(g) Glass liquid level gauges, or gauges of other easily destructible material, which are in direct communication with the contents of the tank are prohibited.

[Amdt. 178–65, 46 FR 9898, Jan. 29, 1981; 46 FR 24184, Apr. 30, 1981, as amended by Amdt. 178–117, 61 FR 50628, Sept. 26, 1996; 66 FR 45386, Aug. 28, 2001]

§ 178.270–13 Testing.

(a) *Hydrostatic test.* Each portable tank and all piping, valves, and other attachments which are subject to the pressure of the contents of the tank, except pressure relief devices, must be hydrostatically tested by completely filling the tank (including domes, if any) with water or other liquid having a similar density and viscosity and applying a pressure of at least 150 percent of the MAWP. The pressure shall be maintained for at least 10 minutes. While under pressure, the tank shall be inspected for leakage, undue distortion, or other conditions which indicate weakness or which might render the tank unsafe for transportation service. Failure to successfully meet the test criteria shall be deemed evidence of failure to meet the requirements of this specification. Tanks failing to pass the test shall be suitably repaired and must successfully pass the prescribed tests prior to use for transporting any hazardous material.

(b) *Testing of internal coils.* Internal coils, if installed, must be hydrostatically tested to an internal pressure of 13.8 bar (200 psig) or 150 percent of the rated pressure of the coils, whichever is greater.

(c) *Tank container qualification test.* For each tank design, a prototype tank, using a framework for containerized transport, must fulfill the requirements of parts 450–453 of this title for compliance with the requirements of Annex II of the International Convention for Safe Containers. In addition, the following tests must be completed without leakage or deformation that would render the tank unsuitable for use:

(1) *Longitudinal inertia.* The tank loaded to its maximum gross weight must be positioned with its longitudinal axis vertical. It shall be held in this position for five minutes by support at the lower end of the base structure providing vertical and lateral restraint and by support at the upper end of the base structure providing lateral restraint only.

(2) *Lateral inertia.* The tank loaded to its maximum gross weight must be positioned for five minutes with its transverse axis vertical. It shall be held in this position for five minutes by support at the lower side of the base structure providing vertical and lateral restraint and by support at the upper side of the base structure providing lateral restraint only.

(d) *Approval of smaller tanks of the same design.* Design approval must include the prototype testing of at least one tank of each design and each size; however, a set of tests made on a tank of one size may serve for the approval of smaller tanks with equal or lesser diameter and length) made of the same material and thickness by the same fabrication technique and with identical supports and equivalent closures and other appurtenances.

(e) *Pressure and vacuum relief devices.* Each spring loaded relief device must be tested for the accuracy of the setting prior to installation on a tank and